

Article

The Influence of Internet-Specific Epistemic Beliefs on Academic Achievement in an Online Collaborative Learning Context for College Students

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Abstract: Online collaborative learning has become a new norm for online teaching at colleges, and improving the quality of online collaborative learning is an inevitable requirement for deepening the information age of education. This paper establishes a multiple mediating effect model based on a self-regulated learning integration model to explore the influence of college students' Internet-specific epistemic beliefs on academic achievement in online collaborative learning contexts. The results of a survey of 503 college students participating in online group collaborative learning showed that college students' Internet-specific epistemic beliefs in online collaborative learning contexts significantly and positively predicted academic achievement. Moreover, college students' metacognitive strategies partially mediated the relationship between Internet-specific epistemic justification and academic achievement. In addition, college students' mastery goal orientation and achievement approach goal orientation had significant partial mediating effects between Internet-specific epistemic beliefs and academic achievement. College students' mastery goal orientation and metacognitive strategies had significant chain mediating effects between Internet-specific epistemic beliefs and academic achievement. Finally, suggestions, significance, limitations, and future research directions are discussed.

Keywords: online collaborative learning; internet-specific epistemic beliefs; metacognitive strategies; achievement goal orientation; academic achievement



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1. Introduction

In recent years, the rapid development of information technology to support teaching and learning activities has triggered a profound change in the way learning takes place, and the adoption of emerging technologies can facilitate better learning outcomes for learners [1]. Online collaborative learning, supported by emerging technologies, is widely used as an effective learning model and has become the new norm for learning [2]. Individual, self-regulated learning is absolutely necessary to achieve optimal productive collaboration [3], so it is especially important that online learners have the self-regulatory ability to control, manage, and plan their learning behaviors [4]. In the online collaborative learning process, students set common goals, standards, and plans [5]. Individuals need to search around and learn the course content on the Internet by themselves; collect and organize information through effective use of the Internet [6]; share useful content to the course group; engage in active interactive sharing, and thus achieve individual and collective knowledge construction; and finally, complete the learning task together. The Internet provides easy access to vast amounts of information on a variety of topics, and learners themselves need to properly evaluate the information on the Internet while searching for it in order to consider it as valid knowledge. Learners' Internet-specific epistemic beliefs are important for their access to correct and reliable information on the Internet [7]. Self-

regulated learning and Internet-specific epistemic beliefs play important roles in online collaborative learning.

Most previous studies have widely used the Technology Acceptance Model (TAM) to investigate learners' behavioral intentions to adopt online collaborative learning [2,8] or to investigate the role of moderating behaviors in online collaborative learning [9–11], but less attention has been paid to the impact of Internet-specific epistemic beliefs on online collaborative learning. The process of online collaborative learning involves the use and sharing of a large number of Internet information resources. Internet-specific epistemic beliefs, as an important factor for students to correctly assess the reliability of Internet information, have an impact on academic achievement in online collaborative learning that should not be underestimated. Because of the lack of research on Internet-specific epistemic beliefs in online collaborative learning contexts, this paper conducts an empirical study to investigate the impact of Internet-specific epistemic beliefs on academic achievement in online collaborative learning contexts from the perspective of self-regulated learning based on the integrated theoretical model of epistemic beliefs and self-regulated learning proposed by Muis [12]. Specifically, two mediating variables, namely achievement goal orientation and metacognitive strategies, are introduced from Internet-specific epistemic beliefs to establish a multiple mediating model that affects academic achievement. The mechanism of the interaction between multiple factors is systematically revealed, and feasible suggestions to improve the quality of online collaborative learning for college students are proposed.

As a whole, this study consists of four major parts. The first part is the theoretical framework, which mainly reviews the self-regulation theory and the foundation of previous studies and puts forward hypotheses; the second part is the methodology, which mainly consists of the elaboration of research methods and analysis of data; the third part is the discussion, which mainly draws research conclusions based on data analysis and gives corresponding research recommendations; finally, the fourth part summarizes the study and discusses its innovations and future research.

2. Theoretical Framework

2.1. Integrated Model of Epistemic Beliefs and Self-Regulated Learning

Self-regulated learning was proposed by Zimmerman [13], who argued that self-regulated learning is determined by the interaction of the individual, environment, and behavior. Pintrich [14] argued that self-regulated learning is an active and constructive process and consists of three components: cognitive, metacognitive, and motivational. In the development of self-regulated learning, scholars have constructed various theoretical models of self-regulated learning from different perspectives. Zimmerman [15] divided the self-regulated learning model into three stages from a social cognitive perspective: the planning stage, the performance or volitional control stage, and the self-reflection stage. Pintrich [14] emphasized the role of motivation in self-regulated learning, and he constructed a model of self-regulated learning consisting of four stages: (1) pre-consideration, planning, and activation; (2) supervision; (3) control; and (4) response and reflection. Winne and Hadwin [16] explored self-regulated learning from a metacognitive perspective, with a model consisting of four specific stages: (1) task definition; (2) goal setting and planning; (3) control of learning strategies and tactics; and (4) metacognitive adaptation to learning. Muis [12] considered the important role of epistemic beliefs in self-regulated learning, further incorporated epistemic beliefs into the self-regulated learning model by extending and combining Winne and Hadwin's (1998) and Pintrich's [14] self-regulated learning models, and finally proposed a comprehensive theoretical model, which is divided into four stages, including task definition, planning and goal setting, enactment, and evaluation.

Among the many theoretical models of self-regulated learning, Muis's theoretical model of self-regulated learning emphasizes the role of epistemic beliefs in self-regulated learning. Based on a review of various theoretical frameworks, models, and empirical work, Muis [12] further identifies four ways in which epistemic beliefs play a role in self-regulated

learning. First, epistemic beliefs are an integral part of the cognitive and affective conditions of the task; second, epistemic beliefs influence the criteria students set when setting goals; third, epistemic beliefs are transformed into epistemic criteria as metacognitive input; and fourth, self-regulated learning may play a role in the development of epistemic beliefs. Overall, she argues that epistemic beliefs are a component of the cognitive and affective conditions of the task during the task definition phase of self-regulated learning and are activated to influence subsequent phases of self-regulated learning, including goal setting, strategy selection and use, and metacognitive activities, all of which, ultimately, affect performance.

2.2. The Relationship between Internet-Specific Epistemic Beliefs and Academic Achievement

Epistemic beliefs are individuals' beliefs about the nature of knowledge and cognition [17], defined specifically as individuals' beliefs about "how knowing occurs, what counts as knowledge and where it resides, and how knowledge is constructed and evaluated" [18], and are domain specific [19]. Bråten et al. [20] used the Internet as a domain context and proposed the concept of Internet-specific epistemic beliefs, i.e., epistemic beliefs held by individuals in the course of online learning, which consists of two dimensions. One is Internet general epistemic beliefs, i.e., whether Internet knowledge is true and from reliable sources; the other is Internet-specific epistemic justification, i.e., Internet knowledge should be verified consistently with other sources and a priori knowledge. Learners' epistemic beliefs are one of the individual factors that influence or determine learners' learning performance and learning strategies [17,21], and mature epistemic beliefs may contribute to their learning activities and academic outcomes [22,23]. Schommer et al. [24] explored the relationship between secondary school students' mathematical epistemic beliefs, mathematical problem-solving beliefs, and mathematics academic performance and found that both general and mathematical domain epistemic beliefs predicted mathematical problem-solving assignment performance and overall grade average performance. Noroozi [25] found that Internet-specific epistemic beliefs were positively related to students' overall argumentative writing performance. Epistemic beliefs affect academic achievement [26], and Internet-specific epistemic beliefs play an important role in the online collaborative learning process and play a key role in the reliability of students' retrieval of online knowledge during the learning process. Therefore, this paper considers students' Internet-specific epistemic beliefs as an important factor in the online collaborative learning process.

2.3. The Mediating Effect of Metacognitive Strategies in Internet-Specific Epistemic Beliefs and Academic Achievement in Online Collaborative Learning

Metacognitive strategies are strategies that help regulate and control cognition to achieve goals, including goal setting, planning, self-monitoring, and self-regulation, and are one of the self-regulated learning strategies [27]. Metacognitive strategies play the most critical role in improving learning outcomes [28]. It has been shown that metacognitive strategies and academic achievement are significantly related [29]. Muis [30] and Ghiasvand [31] examined the effect of metacognitive strategies on academic achievement in traditional learning contexts and found a significant positive correlation between metacognitive strategies and academic achievement. Similarly, Chang [32] and Carson [33] examined the relationship between metacognitive strategies and academic achievement in an online learning context and also found that metacognitive strategies positively affected academic achievement. Online collaborative learning requires students to have strong self-regulated learning skills, and metacognitive strategies are key to students' self-regulated learning. Therefore, this paper concluded that students' metacognitive strategies play an important role in influencing online collaborative learning academic achievement during online collaborative learning.

Research has found a direct correlation between epistemic beliefs and metacognitive strategies; e.g., Dahl, Bals, and Turi [34] investigated the relationship between epistemic beliefs and self-regulated learning strategies and found that students who scored higher

on certainty of knowledge in the epistemic beliefs sub-dimension were less likely to use metacognitive strategies, and similarly, students who scored higher on simplicity of knowledge in the epistemic beliefs sub-dimension were also less likely to use metacognitive strategies. Similarly, Braten and Strømsø [35] found that students' Internet-specific epistemic beliefs were related to self-regulatory strategies in online learning. They investigated the effect of Internet-specific epistemic beliefs on self-regulatory learning in an online environment and found that the sub-dimensions of Internet-specific epistemic beliefs explained the differences between students' Internet-based searches, help-seeking, and use of self-regulatory strategies, respectively. Muis's integrated a theoretical model of self-regulated learning and suggested that students' epistemic beliefs may further influence academic achievement by influencing metacognitive strategies, which is supported by research suggesting that students with mature epistemic beliefs use more appropriate learning strategies and achieve higher levels of academic achievement [36]. Schommer [37,38] found that epistemic beliefs influence students' choice of cognitive strategies for learning, which, in turn, affects students' performance on different tasks. Therefore, this paper suggests that students' Internet-specific epistemic beliefs during online collaborative learning may indirectly affect academic achievement by influencing students' metacognitive strategies.

2.4. Mediating Effects of Achievement Goal Orientation in Internet-Specific Epistemic Beliefs and Online Collaborative Learning Academic Achievement

Midgley, Kaplan, and Middleton [39] defined achievement goals as “behavioral purposes perceived or pursued in a competence-related context”. A.J. Elliot [40] proposed that approach and avoidance motivation should be included in the theoretical framework of achievement goals, forming a three-factor theory of achievement goal orientation, and further divided achievement goals into achievement approach goal orientation and achievement avoidance goal orientation, which, together with mastery goal orientation, constitute the three factors of achievement goal orientation. Achievement approach goal orientation students prefer to demonstrate that they are more capable than other students and tend to make favorable judgments about their own abilities. Individuals with an achievement avoidance goal orientation are rooted in a fear of failure [41] and focus on how to avoid their own mistakes and shortcomings in comparison to others and avoid appearing more incompetent than their peers. Mastery goal orientation learners believe that ability is malleable and effort and ability are covariant. They strive to improve (or prove) their ability and are interested in truly mastering academic tasks. Self-regulatory learning theoretical models suggest that achievement goal orientations are closely related to academic achievement and different achievement goal orientations correspond to different achievement outcomes. Previous research has found that achievement goal orientations directly affect academic achievement. Zhou et al. [42] found that the achievement goal orientation sub-dimension of mastery goal orientation was predictive of college students' academic achievement by examining the relationship between college students' self-directed learning, achievement goal orientations, and academic achievement. Muis's integrated a theoretical model of self-regulated learning and suggested that epistemic beliefs influence achievement goal orientations. Some empirical evidence supports this view, with scholars finding that epistemic beliefs predict students' achievement goal orientations and have a significant positive correlation with mastery goal orientations [43,44]. Therefore, this paper concludes that students' achievement goal orientations play an important role in influencing academic achievement during online collaborative learning, and Internet-specific epistemic beliefs may also indirectly influence academic achievement by affecting students' achievement goal orientations.

2.5. Chain Mediating Effects of Achievement Goal Orientation and Metacognitive Strategies in Internet-Specific Epistemic Beliefs and Online Collaborative Learning Academic Achievement

Self-regulated learning theoretical models suggest that achievement goal orientation is an important factor influencing learners' metacognitive strategy use. Several empirical studies also support this idea. Chan et al. [45] found that students who scored high on

mastery goal orientation in achievement goal orientation were more likely to use cognitive strategies for deep cognitive processing, and mastery goal orientation was also found to be positively associated with metacognitive strategies (including planning, monitoring, and regulating learning) [41]. In a similar study, Yesim Somuncuoglu and Ali Yildirim [46] found that the achievement goal orientation sub-dimension of mastery goal orientation predicted the use of metacognitive strategies through a survey of 189 students participating in an undergraduate educational psychology course. Therefore, this paper concludes that college students' achievement goal orientation also influences college students' metacognitive strategies in an online collaborative learning environment.

Muis's integrated a theoretical model of self-regulation and suggested that epistemic beliefs may influence academic achievement by influencing achievement goal orientation, and thus metacognitive strategies. Muis and Franco [30] used the integrated model and also revealed empirically that epistemic beliefs influence the process of self-regulated learning through the learning standards set by students. The results of structural equation modeling revealed that epistemic beliefs influence the type of achievement goals students adopt, which, in turn, influences the type of learning strategies they use in the educational process, and their achievement. Specifically, achievement goal orientation mediated the relationship between epistemic beliefs and learning strategies; metacognitive strategies, critical thinking, rehearsal strategies, and retelling strategies mediated the relationship between achievement goals and academic achievement to varying degrees. In summary, this paper suggests that similar relationships should exist between college students' achievement goal orientation, college students' metacognitive strategies, college students' Internet-specific epistemic beliefs, and college students' academic achievement in an online collaborative learning environment.

2.6. Hypotheses

The review of the literature suggests that college students' Internet-specific epistemic beliefs are not only directly related to their academic achievement, but also indirectly related to their academic achievement through achievement goal orientation and metacognitive strategies. The purpose of this paper is to explore the relationship between college students' Internet-specific epistemic beliefs, achievement goal orientation, metacognitive strategies, and academic achievement in an online collaborative learning context. To this end, a research model was developed, as shown in Figure 1. The research hypotheses are as follows:

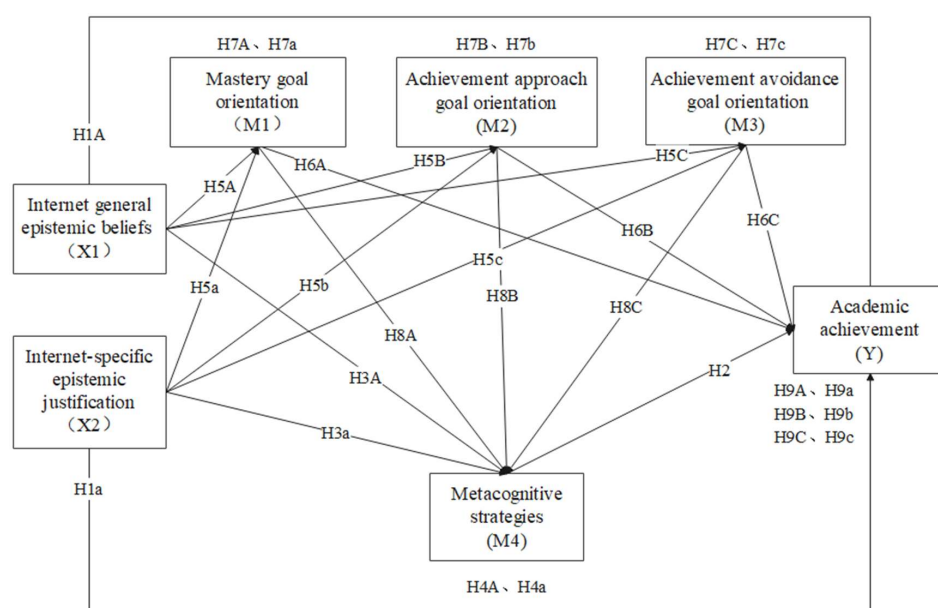


Figure 1. The established research model in this paper.

Hypothesis 1. *In online collaborative learning environments, college students' Internet general epistemic beliefs (H1A) and college students' Internet-specific epistemic justification (H1a) significantly and positively affect college students' academic achievement.*

Hypothesis 2. *Metacognitive strategies of college students in online collaborative learning environments significantly and positively affect college students' academic achievement.*

Hypothesis 3. *In online collaborative learning environments, college students' Internet general epistemic beliefs (H3A) and college students' Internet-specific epistemic justification (H3a) significantly and positively influence college students' metacognitive strategies.*

Hypothesis 4. *In online collaborative learning environments, college students' Internet general epistemic beliefs (H4A) and college students' Internet-specific epistemic justification (H4a) have a significant positive effect on college students' academic achievement through their metacognitive strategies.*

Hypothesis 5. *In online collaborative learning environments, college students' Internet general epistemic beliefs and Internet-specific epistemic justification significantly and positively influence college students' mastery goal orientation (H5A, H5a), achievement approach goal orientation (H5B, H5b) and achievement avoidance goal orientation (H5C, H5c).*

Hypothesis 6. *In online collaborative learning environments, college students' mastery goal orientation (H6A), achievement approach goal orientation (H6B), and achievement avoidance goal orientation (H6C) significantly and positively affect college students' academic achievement.*

Hypothesis 7. *In online collaborative learning environments, college students' Internet general epistemic beliefs and Internet-specific epistemic justification are proved to have a significant positive effect on college students' academic achievement through their mastery goal orientation (H7A, H7a), achievement approach goal orientation (H7B, H7b), and achievement avoidance goal orientation (H7C, H7c).*

Hypothesis 8. *Mastery goal orientation (H8A), achievement approach goal orientation (H8B), and achievement avoidance goal orientation (H8C) significantly and positively influence college students' metacognitive strategies in an online collaborative learning environment.*

Hypothesis 9. *Mastery goal orientation (H9A, H9a), achievement approach goal orientation (H9B, H9b), and achievement avoidance goal orientation (H9C, H9c) and college students' metacognitive strategies play a chain mediating role in the relationship between college students' general Internet-specific epistemic beliefs, Internet-specific epistemic justification, and college students' academic achievement in an online collaborative learning environment.*

3. Methodology

3.1. Research Context

The present study was started in March 2022, when China was in the context of the COVID-19 pandemic. As in most countries around the world, COVID-19 broke the teaching plan of traditional school education [47,48], and a large-scale online teaching practice was launched in China's higher education system, with schools at all levels starting to use online learning platforms to actively respond to the national call of "stopping classes without stopping school". Online collaborative learning, in the form of groups for wisdom convergence and thought construction, has become a widely adopted learning method in education in the post-epidemic era. The data for this study were obtained from the research integration questionnaire "Online Learning of College Students". The author issued an electronic questionnaire through the Questionnaire Star platform to ask college students who participated in online group collaboration to evaluate their own online collaborative

learning process. Undergraduate students from the School of Fisheries, the School of Information Engineering, the School of Clinical Medicine, and the School of Software in four universities in Henan Province and Sichuan Province were selected as the research objects. All of these students have participated in online collaborative learning courses and are familiar with the collaborative learning process.

3.2. Instruments

Four questionnaires were used to investigate college students' Internet-specific epistemic beliefs, metacognitive strategies, achievement goal orientation, and academic achievement in online collaborative course learning. Items in all four questionnaires were administered on a 7-point Likert scale (from 1, "Completely Disagree", to 7, "Completely Agree").

3.2.1. Internet-Specific Epistemic Beliefs Questionnaire

The Internet-specific epistemic beliefs questionnaire for college students was adapted from the Internet-Specific Epistemological Questionnaire (ISEQ) developed by Bråten et al. [20], which is widely used by researchers [49,50]. The ISEQ questionnaire originally had 36 items, including Internet certainty, simplicity, beliefs about the source of knowledge, and Internet-specific epistemic justification. Bråten et al. [20] further identified two dimensions of Internet-specific epistemic beliefs that are Internet general epistemic beliefs and Internet-specific epistemic justification. The original questionnaire has 18 items and the Cronbach's alphas were 0.90 and 0.70. This paper revised the questionnaire and added the contextual condition of online collaborative learning; e.g., one of the items was "In the process of collaborative learning, I believe that learning is mainly about acquiring and referring to knowledge retrieved from the Internet, and my own opinions and understanding are not important. (Reverse)", and another item was "In the collaborative learning process, I judge the reliability of the online knowledge or resources I acquire based on the opinions of most people or authorities". After the pre-survey to remove unreasonable items, the questionnaire consisted of 10 items, and the Cronbach's alphas of the revised two subscales were 0.874 and 0.843, respectively, in which the Internet general epistemic beliefs were reverse scored, and the higher the score, the more mature the Internet-specific epistemic beliefs. The fitting results of confirmatory factor modeling in this study: chi-square/free = 2.387, GFI = 0.972, AGFI = 0.950, NFI = 0.969, IFI = 0.982, TLI = 0.972, CFI = 0.982, RFI = 0.953, RMSEA = 0.053, SRMR = 0.046.

3.2.2. Metacognitive Strategy Questionnaire

The Motivation and Strategy for Learning Questionnaire (MSLQ) developed by Pintrich et al. [27] has been widely used by researchers to measure students' self-regulated learning strategies [51], and the authors have determined the internal consistency, reliability, and predictive validity of the MSLQ [52]. The metacognitive strategies subscale of the MSLQ is selected for revision in this paper. The original scale contained 12 items with a Cronbach's alpha of 0.713. The scale is revised in this paper with the addition of a contextual condition for online collaborative learning, where higher scores are associated with more frequent use of metacognitive strategies. For example, one of the items is "I would change the way I read the reading material in the online collaborative learning course if it was difficult to understand", and another is "I would ask myself questions to make sure I understood what I was learning in the online collaborative learning course". After the pre-survey to remove unreasonable questions, the questionnaire has 8 items, and the Cronbach's alpha of the revised scale is 0.911. The fitting results of confirmatory factor modeling in this paper: chi-square/free = 4.208, GFI = 0.967, AGFI = 0.926, NFI = 0.971, IFI = 0.978, TLI = 0.961, CFI = 0.961, and CFI = 0.961. 0.961, CFI = 0.978, RFI = 0.949, RMSEA = 0.080, SRMR = 0.0299.

3.2.3. Achievement Goal Orientation Questionnaire

The Achievement Goal Orientation Questionnaire developed by Elliot and Church [40] has been widely used by researchers to measure students' achievement goal orientations [45]. The original questionnaire consisted of 18 items, including three major categories: (1) Achievement Approach Goal Orientation; (2) Achievement Avoidance Goal Orientation; (3) Mastery Goal Orientation. The Cronbach's alphas for the three dimensions are 0.91, 0.77, and 0.89, respectively. The questionnaire is revised in this paper with the addition of contextual conditions for online collaborative learning. For example, one of the items is "I like that online collaborative learning classes provide really challenging learning content so I can learn new things", and another item is "I am trying to prove that I am more capable than others in my class in an online collaborative learning course". After the pre-survey to remove unreasonable items, there are 10 items in the questionnaire, and the Cronbach's alphas of the revised three subscales are 0.832, 0.801, and 0.809, respectively. Higher scores of subjects on each dimension indicate stronger orientation to that goal. The fitting results of confirmatory factor modeling in this study: $\chi^2/\text{df} = 2.537$, GFI = 0.968, AGFI = 0.947, NFI = 0.960, IFI = 0.975, TLI = 0.966, CFI = 0.975, RFI = 0.946, SRMR = 0.055.

3.2.4. Academic Achievement Questionnaire

The performance evaluation questionnaire developed by domestic scholar Wang Yanfei has been widely revised or adapted by researchers into an academic achievement questionnaire for college students (Appendix A). For example, Zhou et al. [42] revised Wang Yanfei's performance evaluation questionnaire and used it to measure college students' academic achievement in the investigation of the relationship between college students' self-directed learning, achievement goal orientation, and academic achievement, and the total Cronbach's alpha of the questionnaire was 0.88. In this study, we used Su Peipei's revised "College Students' Academic Achievement Questionnaire" based on Wang Yanfei's performance evaluation questionnaire and then added the contextual conditions of online collaborative learning. For example, one of the items is "When I encountered difficulties in online collaborative learning, I persisted in overcoming them to complete the learning tasks", and another is "I have put forth a high level of effort in online collaborative learning". The Cronbach's alpha of the revised scale was 0.891. The higher the score, the higher the level of academic achievement, and the more significant the academic achievement. The fitting results of confirmatory factor modeling in this study: $\chi^2/\text{df} = 3.868$, GFI = 0.976, AGFI = 0.939, NFI = 0.976, IFI = 0.982, TLI = 0.965, CFI = 0.982, RFI = 0.954, RMSEA = 0.076, SRMR = 0.0253.

3.2.5. Data Collection and Analysis

The questionnaire was distributed online through the Questionnaire Star platform and the collection period is about one week. A total of 614 pieces of data covering four specialties were collected in Xinxiang City and Anyang City in Henan Province and Chengdu City in Sichuan Province; 503 valid questionnaires remained after deleting invalid questionnaires, with a recovery rate of 81.92%, among which 183 are male students, accounting for 36.4%, and 320 are female students, accounting for 63.6%. SPSS24.0 and AMOS24.0 were used for statistical analysis of the data. Similarly, the Process plug-in for SPSS was used for the data analysis in this study, as it can help build path analysis models for observable variables and can be used to perform mediating and moderating effects analysis, providing additional results for direct and indirect effects, as well as Bootstrap confidence intervals and Sobel tests. In addition, it can handle more complex models with multiple mediators, multiple moderators, and moderated mediators. In our study, the hypothetical relationships between the variables are very complex, so we chose to use the Process plug-in for hypothesis validation analysis. First, the variables were tested for multicollinearity and common method bias. Second, the mean and standard deviations of each variable in the study model were calculated for subsequent correlation and regression analyses. Then, the reliability tests of the measurement models were performed. Finally, in the multiple mediation test

stage, the validation analysis was performed using the Process plug-in model 80 written by Hayes.

4. Results

4.1. Common Method Bias and Multicollinearity Tests

This study used self-reported data and therefore may suffer from common method bias, which is a systematic error of artificial covariation that seriously confounds the findings and potentially misleads the conclusions [53]. The possible common method bias in this study was controlled by using anonymous, forward, and backward scoring in the measuring process. Based on this, the common method bias was further examined using the “control for unmeasured single method latent factor method”. First, validation factor analysis model M1 was constructed, and second, model M2 with the method factor was constructed, and the main fit indices of model M1 and model M2 were compared: $\Delta CFI = 0.012$, $\Delta IFI = 0.013$, $\Delta TLI = 0.014$, and $\Delta RMSEA = 0.005$. The changes of the fit indices were less than 0.03, indicating that the model was not significantly improved by adding the common method factor and there was no significant common method bias in the measurements. If the variance inflation factor (VIF) values of the respective variables were less than 5, there was no multicollinearity problem; the VIF value was less than 10, indicating that the multicollinearity problem was not serious [54]. The results showed that the VIF values ranged from 1.369–5.165, which was less than the critical value of 10, indicating that the multicollinearity problem was not serious.

4.2. Descriptive Statistics and Correlation among Variables

The results of descriptive statistics and correlations of college students' Internet general epistemic beliefs, Internet-specific epistemic justification, mastery goal orientation, achievement approach goal orientation, achievement avoidance goal orientation, metacognitive strategies, and online collaborative learning academic achievement are shown in Table 1. In terms of means (seven-point scale $M = 4$), college students had more mature Internet-specific epistemic beliefs, including Internet general epistemic beliefs ($M = 4.417$, $SD = 1.322$), Internet-specific epistemic justification ($M = 5.456$, $SD = 0.896$), and stronger achievement goal orientation for online learning, including mastery goal orientation ($M = 5.365$, $SD = 0.873$), achievement approach goal orientation ($M = 5.040$, $SD = 1.113$), and achievement avoidance goal orientation ($M = 4.999$, $SD = 1.154$). Students perceived a higher use of metacognitive strategies in their own online learning ($M = 5.305$, $SD = 0.866$) and a relatively high level of recognition of their collaborative online group academic achievement ($M = 5.256$, $SD = 0.873$). College students' Internet general epistemic beliefs and Internet-specific epistemic justification proved to be significantly related to mastery goal orientation, achievement approach goal orientation, achievement avoidance goal orientation, metacognitive strategies, and academic achievement. College students' mastery goal orientation, achievement approach goal orientation, and achievement avoidance goal orientation were significantly related to metacognitive strategies and academic achievement. There is also a significant correlation between metacognitive strategies and academic achievement among college students.

4.3. Analysis of Measurement Models

4.3.1. Reliability and Convergent Validity

In order to examine and confirm the convergent validity and discriminant validity of each variable, this study used SPSS24.0 and Amos24.0 software to conduct reliability analysis and validation factor analysis on the data, using Cronbach's alpha coefficient and combined reliability (CR) to measure the consistency among the question items under the same measurement dimension. As seen in Table 2, the lowest Cronbach's alpha coefficient among the eight measurement dimensions was 0.801 and the lowest combined reliability coefficient was 0.806, so the measurement scale used in this study had a high reliability, indicating a good internal consistency. Convergent validity was also examined in this study

using standardized factor loadings and average extracted variance (AVE), and as shown in Table 2, the minimum value of average extracted variance for each measurement dimension in this study was 0.519, which is greater than the threshold value of 0.5 [55]. This indicates that the scale used in this study has good convergent validity.

Table 1. Descriptive statistics and correlation of variables.

Variables	M	SD	Relevance						
			1	2	3	4	5	6	7
GEN	4.417	1.322	--						
JUS	5.456	0.896	0.272 **	--					
MAS	5.365	0.873	0.319 **	0.772 **	--				
APP	5.040	1.113	0.332 **	0.377 **	0.421 **	--			
AVO	4.999	1.154	0.472 **	0.251 **	0.273 **	0.582 **	--		
MET	5.305	0.866	0.347 **	0.825 **	0.855 **	0.443 **	0.312 **	--	
ACH	5.256	0.873	0.364 **	0.833 **	0.864 **	0.472 **	0.281 **	0.886 **	--

Note: GEN = Internet general epistemic beliefs; JUS = Internet-specific epistemic justification; MAS = mastery goal orientation; APP = achievement approach goal orientation; AVO = achievement avoidance goal orientation; MET = metacognitive strategies; ACH = academic achievement; ** $p < 0.01$.

Table 2. Reliability and convergent validity tests of the measurement model.

Structure Variables	Measurement Variables	Standard Factor Loadings	AVE	CR	Alpha Coefficient
GEN	GEN1	0.717	0.565	0.886	0.874
	GEN2	0.827			
	GEN3	0.680			
	GEN4	0.777			
	GEN5	0.754			
	GEN6	0.747			
JUS	JUS1	0.623	0.565	0.837	0.843
	JUS2	0.786			
	JUS3	0.752			
	JUS4	0.830			
MAS	MAS1	0.735	0.519	0.812	0.809
	MAS2	0.726			
	MAS3	0.744			
	MAS4	0.673			
APP	APP1	0.756	0.627	0.834	0.832
	APP2	0.784			
	APP3	0.834			
AVO	AVO1	0.786	0.581	0.806	0.801
	AVO2	0.715			
	AVO3	0.783			
MET	MET1	0.804	0.558	0.910	0.911
	MET2	0.711			
	MET3	0.741			
	MET4	0.751			
	MET5	0.779			
	MET6	0.745			
	MET7	0.709			
	MET8	0.731			

Table 2. Cont.

Structure Variables	Measurement Variables	Standard Factor Loadings	AVE	CR	Alpha Coefficient
ACH	ACH1	0.778	0.538	0.890	0.891
	ACH2	0.668			
	ACH3	0.672			
	ACH4	0.757			
	ACH5	0.722			
	ACH6	0.775			
	ACH7	0.756			

Note: GEN = Internet general epistemic beliefs; JUS = Internet-specific epistemic justification; MAS = mastery goal orientation; APP = achievement approach goal orientation; AVO = achievement avoidance goal orientation; MET = metacognitive strategies; ACH = academic achievement.

4.3.2. Discriminant Validity

Before testing the research hypotheses, this study conducted validated factor analyses on a total of seven latent variables: Internet general epistemic beliefs, Internet-specific epistemic justification, mastery goal orientation, achievement approach goal orientation, achievement avoidance goal orientation, metacognitive strategies, and academic achievement, and the discriminant validity of the scales was assessed by comparing multifactorial models (see Table 3). The seven-factor model was the best fit compared to the other six models ($\chi^2 = 1549.033$; $df = 529$; $\chi^2/df = 2.928$; IFI = 0.912; TLI = 0.901; CFI = 0.912; RMSEA = 0.062; SRMR = 0.051), and significantly better than the other alternative models. Therefore, the seven variables designed for this study can indeed represent seven different concepts, and the measurement has good discriminant validity.

4.4. Direct Effect Analysis

The direct effects were first tested using cascade regression, as shown in Table 4, and model 6, with the introduction of control variables, showed that the two dimensions of Internet-specific epistemic beliefs, i.e., Internet general epistemic beliefs ($\beta = 0.103$, $p = 0.000$) and Internet-specific epistemic justification ($\beta = 0.770$, $p = 0.000$), had a significant positive effect on academic achievement; hypotheses H1A and H1a were tested. From the regression coefficients of model 8, metacognitive strategies have a significant positive effect on academic achievement ($\beta = 0.897$, $p = 0.000$); hypothesis H2 was verified. From the regression coefficients of model 4, both Internet general epistemic beliefs and Internet-specific epistemic justification have significant positive effects on metacognitive strategies ($\beta = 0.088$, $p = 0.000$; $\beta = 0.754$, $p = 0.000$); hypotheses H3A and H3a were verified. From the regression coefficients of models 1, 2, and 3, both Internet general epistemic beliefs and Internet-specific epistemic justification have significant positive effects on the three dimensions of achievement goal orientation that are mastery goal orientation ($\beta = 0.077$, $p = 0.000$; $\beta = 0.711$, $p = 0.000$), achievement approach goal orientation ($\beta = 0.206$, $p = 0.000$; $\beta = 0.386$, $p = 0.000$), and achievement avoidance goal orientation ($\beta = 0.388$, $p = 0.000$; $\beta = 0.0170$, $p = 0.000$); hypotheses H5A, H5a, H5B, H5b, H5C, and H5c were verified. From the regression coefficients of models 5 and 7, both mastery goal orientation and achievement approach goal orientation have significant positive effects on metacognitive strategies ($\beta = 0.799$, $p = 0.000$; $\beta = 0.059$, $p = 0.012$) and academic achievement ($\beta = 0.815$, $p = 0.000$; $\beta = 0.115$, $p = 0.000$); hypotheses H6A, H6B, H8A, and H8B were verified. However, the effect of achievement avoidance goal orientation on both metacognitive strategies and academic achievement was not significant; hypotheses H6C and H8C were not verified.

Table 3. Confirmatory factor analysis results (N = 503).

Number	Models	χ^2	df	χ^2/df	IFI	TLI	CFI	RMSEA	SRMR	Model Comparison	$\Delta\chi^2$	Δdf
1	Seven-factor model	1549.033	529	2.928	0.912	0.901	0.912	0.062	0.0510			
2	Six-factor model	2118.041	535	3.959	0.864	0.848	0.863	0.077	0.0701	2 vs. 1	569.008 ***	6
3	Five-factor model	2163.03	540	4.006	0.860	0.845	0.86	0.077	0.0724	3 vs. 1	613.997 ***	11
4	Four-factor model	2682.546	544	4.931	0.816	0.798	0.815	0.088	0.0881	4 vs. 1	1133.513 ***	15
5	Three-factor model	2692.555	547	4.922	0.815	0.798	0.815	0.088	0.0884	5 vs. 1	1143.522 ***	18
6	Two-factor model	2692.273	548	4.913	0.815	0.799	0.815	0.088	0.0886	6 vs. 1	1143.24 ***	19
7	One-factor model	3597.989	549	6.554	0.738	0.714	0.736	0.105	0.1073	7 vs. 1	2048.956 ***	20

Note: *** $p < 0.001$; the seven-factor model is metacognitive strategies, achievement approach goal orientation, Internet-specific epistemic justification, achievement avoidance goal orientation, academic achievement, mastery goal orientation, and Internet general epistemic beliefs; the six-factor model is metacognitive strategies + achievement approach goal orientation, Internet-specific epistemic justification, achievement avoidance goal orientation, academic achievement, mastery goal orientation, and Internet general epistemic beliefs; the five-factor model is metacognitive strategies + achievement approach goal orientation + Internet-specific epistemic justification, achievement avoidance goal orientation, academic achievement, mastery goal orientation, and Internet general epistemic beliefs; the four-factor model is metacognitive strategies + achievement approach goal orientation + Internet-specific epistemic justification + achievement avoidance goal orientation, academic achievement, mastery goal orientation, and Internet general epistemic beliefs; the three-factor model is metacognitive strategies + achievement approach goal orientation + Internet-specific epistemic justification + achievement avoidance goal orientation + academic achievement, mastery goal orientation, and Internet general epistemic beliefs; the two-factor model is metacognitive strategies + achievement approach goal orientation + Internet-specific epistemic justification + achievement avoidance goal orientation + academic achievement + mastery goal orientation, and Internet general epistemic beliefs; and the one-factor model is metacognitive strategies + achievement approach goal orientation + Internet-specific epistemic justification + achievement avoidance goal orientation + academic achievement + mastery goal orientation + Internet general epistemic beliefs.

Table 4. Analysis of direct effects.

Variables	MAS	APP	AVO	MET		ACH		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Grade	−0.021	−0.023	0.040	−0.023	−0.034	−0.009	−0.016	−0.006
Age	−0.042	0.036	−0.016	−0.031	−0.003	−0.019	0.010	0.009
Gender	−0.046	−0.017	0.041	−0.008	−0.002	0.061	0.060	0.038
Specialty	0.081	−0.031	−0.158	0.049	−0.018	0.032	−0.043	−0.018
GEN	0.077 ***	0.206 ***	0.388 ***	0.088 ***	--	0.103 ***	--	--
JUS	0.711 ***	0.386 ***	0.170 **	0.754 ***	--	0.770 ***	--	--
MAS	--	--	--	--	0.799 ***	--	0.815 ***	--
APP	--	--	--	--	0.059 *	--	0.115 ***	--
AVO	--	--	--	--	0.035	--	−0.020	--
MET	--	--	--	--	--	--	--	0.897 ***
R2	0.618	0.200	0.248	0.701	0.743	0.716	0.763	0.787
Adj.R2	0.613	0.190	0.239	0.697	0.739	0.712	0.760	0.784
R2 Amount of change	0.568	0.189	0.236	0.656	0.698	0.685	0.733	0.756
F-value	133.624 ***	20.674 ***	27.279 ***	193.716 ***	204.360 ***	208.254 ***	228.151 ***	366.250 ***

Note: GEN = Internet general epistemic beliefs; JUS = Internet-specific epistemic justification; MAS = mastery goal orientation; APP = achievement approach goal orientation; AVO = achievement avoidance goal orientation; MET = metacognitive strategies; ACH = academic achievement. Non-standardized coefficients are reported; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.5. Multiple Mediation Effects of Internet-Specific Epistemic Beliefs on College Students' Academic Achievement

Based on the research hypotheses, a multiple mediation model between Internet-specific epistemic beliefs, metacognitive strategies, achievement goal orientation, and academic achievement was constructed. Model 80 in the Process plug-in of the SPSS macro program developed by Hayes was used to conduct chain mediated effects analysis as well as to test the indirect effects of Internet-specific epistemic beliefs and academic achievement. Using the Bootstrap method [56], a sample size of 5000 was set, 95% confidence intervals were constructed, and indirect effects were calculated for the multiple mediator condition, and the results of the multiple mediator effect tests are shown in Table 5.

Table 5. Test results of multiple mediating effects.

Intermediary Effect	Effect Type	Effect Path	Effect	Boot SE	Effect Amount (%)	Boot LLCI	Boot ULCI
GEN → ACH	Direct effect	GEN → ACH	0.043	0.014	17.92	0.015	0.070
		MAS	0.079	0.015	32.92	0.051	0.111
		APP	0.023	0.007	9.58	0.010	0.039
		AVO	−0.024	0.010	10.00	−0.045	−0.004
	Intermediary effect	MET	0.019	0.011	7.92	−0.002	0.040
		MAS → MET	0.088	0.015	36.67	0.060	0.119
		APP → MET	0.008	0.005	3.33	0.000	0.019
		AVO → MET	0.004	0.006	1.67	−0.008	0.017
		GEN → ACH	0.197	0.029	82.08	0.140	0.257
		GEN → ACH	0.240	0.027	100.0	0.186	0.294
JUS → ACH	Direct effect	JUS → ACH	0.240	0.031	29.59	0.180	0.300
		MAS	0.238	0.032	29.35	0.173	0.303
		APP	0.038	0.012	4.69	0.017	0.065
		AVO	−0.011	0.007	1.36	−0.027	0.002
	Intermediary effect	MET	0.147	0.025	18.13	0.100	0.200
		MAS → MET	0.148	0.025	18.25	0.103	0.201
		APP → MET	0.007	0.005	0.86	−0.001	0.018
		AVO → MET	0.004	0.003	0.49	−0.001	0.011
		JUS → ACH	0.571	0.034	70.41	0.508	0.640
		JUS → ACH	0.811	0.024	100.0	0.764	0.859

Note: GEN = Internet general epistemic beliefs; JUS = Internet-specific epistemic justification; MAS = mastery goal orientation; APP = achievement approach goal orientation; AVO = achievement avoidance goal orientation; MET = metacognitive strategies; ACH = academic achievement. Non-standardized effect values are reported.

According to the Bootstrap test, the mediating effects of mastery goal orientation and achievement approach goal orientation in the effects of Internet general epistemic beliefs (95CI: LLCI = 0.051, ULCI = 0.111, excluding 0; LLCI = 0.010, ULCI = 0.039, excluding 0) and Internet-specific epistemic justification (LLCI = 0.173, ULCI = 0.303; LLCI = 0.017, ULCI = 0.065) on academic achievement hold with positive coefficients (0.079; 0.023; 0.238; 0.038), confirming hypotheses H7A, H7B, H7a, and H7b; while the mediating effect of achievement avoidance goal orientation in Internet general epistemic beliefs (LLCI = −0.045, ULCI = −0.004, Effect = −0.024) and academic achievement was significant but with a negative coefficient not in line with the hypothesis, and a non-significant and negative coefficient in Internet-specific epistemic justification (LLCI = −0.027, ULCI = −0.002, Effect = −0.011) and academic achievement; hypotheses H7C and H7c were not confirmed. Table 6 shows that the mediating effect of metacognitive strategies in the relationship between Internet general epistemic beliefs (LLCI = −0.002, ULCI = 0.040, Effect = 0.019) and academic achievement was not significant and hypothesis H4A was not confirmed, but the mediating effect in the relationship between Internet-specific epistemic justification (LLCI = 0.100, ULCI = 0.200, Effect = 0.147) and academic achievement was significant and positive; hypothesis H4a was confirmed. The chain mediation between mastery goal orientation and metacognitive strategies in Internet general epistemic beliefs (LLCI = 0.060, ULCI = 0.119,

Effect = 0.088), Internet-specific epistemic justification (LLCI = 0.103, ULCI = 0.201, Effect = 0.148), and academic achievement held. However, the chain mediating effects of achievement approach goal orientation, achievement avoidance goal orientation, and metacognitive strategies in Internet general epistemic beliefs, Internet-specific epistemic justification, and academic achievement were not significant; hypotheses H9B, H9b, H9C, and H9c were not confirmed. As shown in Table 5, the total effect value of Internet general epistemic beliefs on academic achievement was 0.240 (95% Bias-Corrected CI = [0.186, 0.294]) and the total indirect effect value was 0.197, accounting for 82.08% of the total effect value. The total effect value of Internet-specific epistemic justification on academic achievement was 0.811 (95% Bias-Corrected CI = [0.764, 0.859]) and the total indirect effect value was 0.571, accounting for 70.41% of the total effect value. The relationships between the specific model variables and the effect coefficients are shown in Figures 2 and 3, and the hypothesized validation relationships are shown in Table 6.

Table 6. Results of hypothesis testing.

Hypotheses	Results
Hypothesis 1. In online collaborative learning environments, college students' Internet general epistemic beliefs (H1A) and college students' Internet-specific epistemic justification (H1a) significantly and positively affect college students' academic achievement.	Established
Hypothesis 2. Metacognitive strategies of college students in online collaborative learning environments significantly and positively affect college students' academic achievement.	Established
Hypothesis 3. In online collaborative learning environments, college students' Internet general epistemic beliefs (H3A) and college students' Internet-specific epistemic justification (H3a) significantly and positively influence college students' metacognitive strategies.	Established
Hypothesis 4. In online collaborative learning environments, college students' Internet general epistemic beliefs (H4A) and college students' Internet-specific epistemic justification (H4a) have a significant positive effect on college students' academic achievement through their metacognitive strategies.	H4a was established
Hypothesis 5. In online collaborative learning environments, college students' Internet general epistemic beliefs and Internet-specific epistemic justification significantly and positively influenced college students' mastery goal orientation (H5A, H5a), achievement approach goal orientation (H5B, H5b), and achievement avoidance goal orientation (H5C, H5c).	Established
Hypothesis 6. In online collaborative learning environments, college students' mastery goal orientation (H6A), achievement approach goal orientation (H6B), and achievement avoidance goal orientation (H6C) significantly and positively affect college students' academic achievement.	H6A, H6B were established
Hypothesis 7. In online collaborative learning environments, college students' Internet general epistemic beliefs and Internet-specific epistemic justification proved to have a significant positive effect on college students' academic achievement through their mastery goal orientation (H7A, H7a), achievement approach goal orientation (H7B, H7b), and achievement avoidance goal orientation (H7C, H7c).	H7A, H7B, H7a, H7b were established
Hypothesis 8. Mastery goal orientation (H8A), achievement approach goal orientation (H8B), and achievement avoidance goal orientation (H8C) significantly and positively influenced college students' metacognitive strategies in an online collaborative learning environment.	H8A, H8B were established
Hypothesis 9. Mastery goal orientation (H9A, H9a), achievement approach goal orientation (H9B, H9b), achievement avoidance goal orientation (H9C, H9c), and college students' metacognitive strategies play a chain mediating role in the relationship between college students' general Internet-specific epistemic beliefs, Internet-specific epistemic justification, and college students' academic achievement in an online collaborative learning environment.	H9A, H9a were established

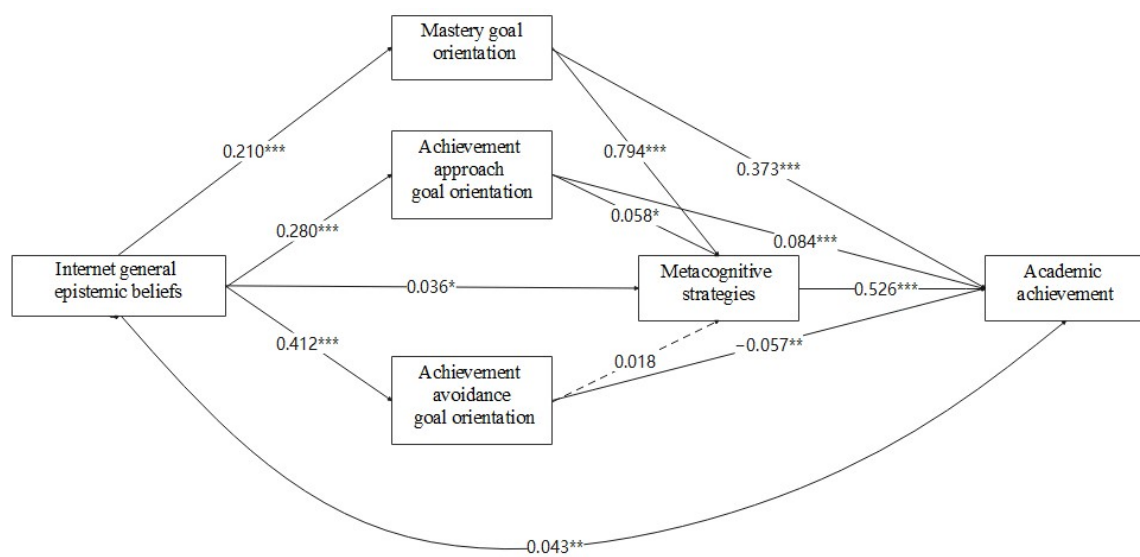


Figure 2. Multiple mediated effect model of Internet general epistemic beliefs and academic achievement. (Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; dashed lines indicate insignificant impact effects).

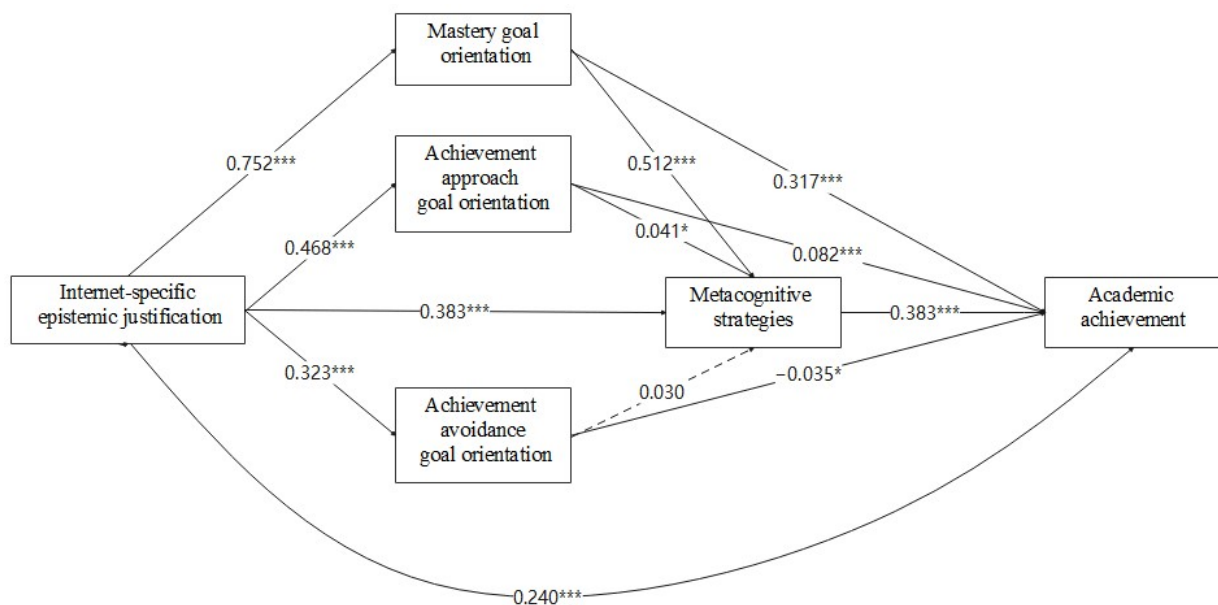


Figure 3. Multiple mediation effect model of Internet-specific epistemic justification and academic achievement (Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; dashed lines indicate insignificant impact effects).

5. Discussion

Based on the perspective of self-regulated learning, this paper constructs a multiple mediating effects model to explore the influence of college students' Internet-specific epistemic beliefs on academic achievement in online collaborative learning contexts, reveals the chain mediating role of achievement goal orientation and metacognitive strategies in the above-mentioned influence process, draws some meaningful conclusions, and provides empirical support for the important role of college students' group self-learning status in online collaborative learning.

First, college students' Internet general epistemic beliefs and Internet-specific epistemic justification both have significant direct and indirect effects on academic achievement, which is largely consistent with the ideas in Muis's integrated self-regulated learning model.

This finding is consistent with previous findings that students who had more sophisticated epistemic beliefs also had higher levels of achievement [57], and conversely, students with more naive epistemic beliefs are more likely to have poorer academic achievement [58]. The more mature students' Internet-specific epistemic beliefs are, with the authenticity of knowledge acquired on the Internet and the reliability of the source cross-verified and checked at the same time, the more accurate the acquired knowledge and information is, and the higher their academic achievement will be. Specifically, in online collaborative learning situations, students rely on information technology support for resource seeking, resource sharing, and, ultimately, intergroup inspiration and perspective sharing [59], and mature Internet-specific epistemic beliefs help students better evaluate acquired knowledge on the Internet, improve the accuracy of their own Internet knowledge retrieval, and thus become more successful in their academic achievement. Conversely, if college students believe that the learning materials they find on the Internet are composed of truthful or conclusive content that will not change over time, they will acquire unreliable learning materials, engage in erroneous knowledge learning, and have lower academic achievement. Nowadays, in the new era of digital education transformation, various emerging technologies are being deeply integrated with education, and the Internet has become an inseparable part of the current educational ecology. Therefore, it is suggested that schools can provide targeted epistemic training after understanding students' Internet-specific epistemic beliefs, as well as conduct group work activities so that they can effectively discuss and communicate with each other during the learning process and cultivate a systematic and developmental view of knowledge on the Internet to promote students' internalized constructive knowledge, thus increasing their immunity to Internet spam and their ability to evaluate Internet information by avoiding the interference of irrelevant information. On the other hand, teachers need to pay attention to the characteristics of students' Internet-specific epistemic beliefs and cultivate students' mature Internet-specific epistemic beliefs through effective ways, such as training and guidance; for example, guiding students to compare and evaluate different viewpoints through critical thinking training, value discernment, and other ways, reflecting on their previous ideas about Internet knowledge, and then making adjustments to their epistemic beliefs to promote students' Dialectical thinking skills.

Second, metacognitive strategies play a partly mediating role in Internet-specific epistemic justification and academic achievement, which is partially consistent with Muis's integration model; i.e., epistemic beliefs affect metacognitive strategies and indirectly influence academic achievement, and the more mature students' Internet-specific epistemic justification is, the more frequently they use metacognitive strategies, and the better their academic achievement. This finding is consistent with previous findings that the more mature students' epistemic beliefs are, the more they tend to use deeper learning strategies in their learning process [60,61]. In online collaborative learning, students need to cooperate with each other through continuous knowledge construction and information sharing, and students' cognitive input becomes especially important in solving the problems faced in collaborative learning, and metacognitive strategies can effectively monitor and control individual cognitive processes and results. The more frequently students use metacognitive strategies, the more effectively they can control their cognitive processes and outcomes, and the more likely they are to succeed in their academic achievement. The more mature students prove to be in Internet-specific epistemic justification, the better they can dialectically evaluate knowledge claims on the Internet, and the more frequently they use metacognitive strategies to monitor their cognitive processes to solve problems in the collaborative learning process. However, the mediating effect of metacognitive strategies in the relationship between college students' Internet general epistemic beliefs and academic achievement did not hold, suggesting that although students hold mature Internet general epistemic beliefs about Internet knowledge and doubt the authenticity of Internet knowledge, the effect of motivating them to use metacognitive strategies and thus influence academic achievement was not obvious. Metacognitive strategies are closely related to autonomous learning, and they help learners take control of autonomous learning

behaviors. The autonomy of learning requires online learners to rely on self-regulation for online learning, and the effectiveness of online learning largely depends on students' ability to self-regulate their learning and actively participate in the learning process [62]. Metacognitive strategy development is the key to self-regulated learning; therefore, it is recommended that schools should pay attention to the guidance and training of college students in the use of metacognitive strategies, formulate relevant activity plans, design online learning platforms to monitor learners' learning behaviors in real time, and promote learners' timely self-regulation through the system's reminder function. On the other hand, teachers can start from the following aspects in the daily teaching process: First, help students fully understand the nature of the learning tasks. Second, help students understand the effect of strategy factors in the task-solving process. Third, guide students to develop a task-solving plan. Fourth, assist students to record and monitor their cognitive learning behaviors during the problem-solving process with the help of self-monitoring forms, self-evaluation forms, and other assistance tools to develop students' self-monitoring ability and reflective learning ability, and to improve students' self-regulated learning ability.

Third, mastery goal orientation and achievement approach goal orientation had significant partial mediating effects between both Internet general epistemic beliefs and Internet-specific epistemic and academic achievement. The mediating effect value of mastery goal orientation is much larger than that of achievement approach goal orientation, which indicates that the more mature students' Internet-specific epistemic beliefs are, the more likely achievement goal orientation students who tend to mastery goal orientation are to achieve well academically than students who tend to achievement approach goal orientation. This finding is consistent with previous findings that mastery goal orientation and achievement approach goal orientation were significantly positively associated with academic achievement, and that mastery goal orientation mediated the effect of intrinsic motivation on academic achievement [45]. In online collaborative learning, students hold mature Internet specific epistemic beliefs, and in the achievement goal orientation, the more inclined they are to mastery goal orientation (more willing to truly master knowledge), the more inclined they are to achievement approach goal orientation (more inclined to learn from the favorable judgment of their own ability). These two kinds of goal orientation will promote better academic achievement. However, performance avoidance goal orientation had a negative mediating effect between college students' Internet general epistemic beliefs and academic achievement, and a non-significant mediating effect between Internet-specific epistemic justification and academic achievement. This suggests that in online collaborative learning, the more students hold mature Internet general epistemic beliefs, the more their goal orientations tend to be toward achievement avoidance goal orientations, which negatively affect academic achievement instead due to insufficient motivation to achieve good academic achievement. With the same mature Internet-specific epistemic justification, the more inclined the goal orientation is to achievement avoidance goal orientation, the less effective it is in influencing academic achievement due to too much focus on how to avoid their own mistakes and deficiencies in comparison with others, and thus the effect on academic achievement is also not significant. Research suggests that school and classroom policies and practices can influence students' goal orientations [63,64], so it is suggested that schools can give students the opportunity to showcase their success through competitions, events, etc., to help them gain confidence and maintain a positive goal orientation. The choice of course resources in the classroom also has a direct impact on the achievement of their goals, so schools can also design online learning spaces to build course resources that meet the different needs of learners and match them with corresponding assignments and exercises to promote the use of positive goal orientations. On the other hand, teachers should help college students choose and set appropriate goals, help students to do goal planning clearly so that they can objectively assess their own situation, and thus guide them to choose positive achievement goal orientation. Teachers also need to further guide students to experience a sense of self-worth and sanity in their studies, to acquire more self-efficacy from their studies so as to maintain a good state of motivation,

and to cultivate students to correctly view academic successes and failures and to make reasonable attributions.

Fourth, the study also found a significant chain mediating effect of mastery goal orientation and metacognitive strategies between Internet general epistemic beliefs, Internet-specific epistemic justification, and academic achievement. This finding is consistent with previous findings that epistemic beliefs influenced the types of achievement goals students adopted, which subsequently influenced the types of learning strategies they used in their education course, and their achievement [30]. It shows that the more mature students' Internet-specific epistemic beliefs are, and the more they are inclined to mastery goal orientation, the more willing they are to actually master knowledge and to use metacognitive strategies for self-monitoring, thus promoting better academic achievement. The chain mediating effects of metacognitive strategies and achievement approach goal orientation were not significant. This indicates that in online collaborative learning, the more mature the Internet-specific epistemic beliefs that students hold, and the more they tend to achievement approach goal orientation, the less significant the effect of using metacognitive strategies on academic achievement. Similarly, for students with mature Internet-specific epistemic beliefs, the more they tended to achievement avoidance goal orientation, the less effective they were in using metacognitive strategies to influence academic achievement because they focused on comparing themselves to others in the learning process to avoid their own mistakes and deficiencies and to avoid appearing more incompetent than their peers. Therefore, it is recommended that schools and teachers include training in the use of metacognitive strategies while setting up and conducting positive goal orientation activities. For example, schools should design online learning spaces to provide course resources for learners' different needs and promote the use of positive goal-directed courses while designing real-time monitoring programs for learners' learning behaviors to promote learners' timely self-regulation. While guiding learners to look at the success or failure of their studies in a correct way, teachers should add tools such as self-monitoring forms and self-evaluation forms to help learners solve problems.

In addition, the improvement of the above-mentioned factors associated with academic achievement in our study could improve not only the knowledge skills of college students in the online collaborative learning process, but also their cognitive perceptions, which, in turn, could improve educational sustainability. At the same time, improvements in online collaborative academic achievement can improve student well-being, and thus the financial sustainability of educational institutions. Further exploration of how Internet-specific epistemic beliefs play a role in different teaching and learning processes is necessary, for students' epistemic beliefs are a core element of their own cognition and one of the important factors influencing educational sustainability.

6. Conclusions, Limitations, and Future Research

Despite the fact that online collaborative learning is a widely adopted learning approach in the educational field in the era of educational informatization [65], not all online collaborative learning results in good learning outcomes [66]. In order to improve the quality of online collaborative learning among university students, this paper firstly examines the relationship between Internet-specific epistemic beliefs and online collaborative academic achievement. It also clarifies the relationships and internal mechanisms of action between Internet-specific epistemic beliefs, achievement goal orientation, metacognitive strategies, and multiple factors of academic achievement of college students in online collaborative learning contexts in relation to their Internet-specific epistemic beliefs, and suggests feasible recommendations for schools and teachers. Specifically, the findings showed that Internet-specific epistemic beliefs, metacognitive strategies, mastery goal orientation, and achievement approach goal orientation each had a significant positive effect on academic achievement. In addition, Internet-specific epistemic beliefs had a significant positive effect on both metacognitive strategies and achievement goal orientation, and mastery goal orientation and achievement approach goal orientation were each significantly and positively

associated with metacognitive strategies. More importantly, in the relationship between Internet-specific epistemic beliefs and academic achievement, metacognitive strategies, mastery goal orientation, and achievement approach goal orientation all play a partial mediating role, while metacognitive strategies and mastery goal orientation together play a chain mediating role.

In addition, this paper not only responds to Pintrich's [17] call for empirical research on how epistemic beliefs affect motivation, strategy use, cognition, and academic achievement, but it also validates the hypothesis of the relationship between epistemic beliefs, goal orientation, learning strategies, and achievement in Muis's integrated model of epistemic beliefs and self-regulated learning, and adds corresponding empirical evidence to Muis's theoretical model. Moreover, the study also responds to the call for sustainable education. Due to the popularity of online collaborative learning approaches, the education sector needs to improve the academic achievement of students within them to maintain the sustainability of online education, as well as focus on the ways in which Internet-specific epistemic beliefs play a role in the teaching–learning process in order to improve student perceptions and to maintain the sustainability of education.

However, there are some limitations in this study, which need to be improved in follow-up studies. First, more advanced methods can be used for data collection. The traditional self-reporting scale has certain shortcomings, and in the context of digital transformation, the study should adopt more emerging technologies for data collection. Second, the subjects in this study were all university students who participated in online collaborative learning, and insufficient attention was paid to other types of online learners. And the findings apply to research contexts similar to this study; other research contexts may differ. Future studies should replicate this investigation in multiple countries, regions, and cultures to correct its shortcomings and expand the scope of its findings. Moreover, the influence of Internet-specific epistemic beliefs of different types of learners on their learning process should be considered in order to reveal the relationship between Internet-specific epistemic beliefs and learning in a more comprehensive way.

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Institutional Review Board Statement: All procedures performed in studies involving human participants were in accordance with the ethical standards of the Institutional Review Board of the Institute of Psychology of the Chinese Academy of Sciences and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data will be made available on reasonable request.

Conflicts of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Academic Achievement Questionnaire

1. When I encountered difficulties in online collaborative learning, I persisted in overcoming them to complete the learning tasks.
2. In online collaborative learning, I work overtime to complete my tasks on time.
3. I put forth a high level of effort in online collaborative learning.

4. The quality of my learning situation is high in online collaborative learning.
5. In online collaborative learning, I complete the learning tasks that meet the teacher's requirements.
6. In online collaborative learning, I actively seek out challenging learning tasks.
7. In online collaborative learning, I take the initiative to solve problems in learning.

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